

Answers to Exercises

Chapter 13

Exercise 13.1

Heat from magma under ice melts the ice. The water produced is denser than the ice melted, potentially making some space available. Also water is very mobile, possibly flowing away to make more space. This could reduce the pressure on the magma and allows gases to exsolve and expand, possibly explosively. Rhyolite is much more viscous than any mafic magma and so it displaces the ice much more slowly. This may allow more time for deformation of the overlying ice, maintaining contact between ice and the magma surface so that the weight of the ice exerts pressure, suppressing gas release from the magma.

Exercise 13.2

The magma forming the sill must exert a pressure that is at least equal to the stress due to the overlying ice, and this is at least equal to the static weight of the ice. This pressure is also capable of supporting a column of magma in a dike penetrating up into the ice above the sill injection point. Magmas are typically up to 3 times denser than ice, and so the distance the dike can penetrate can be at least one third of the ice thickness.

Exercise 13.3

The base of the lava chills very quickly to a low temperature, and so radiant heat emission to the ice or snow, which is proportional to the fourth power of the lava temperature, quickly becomes negligible. Subsequent heat transfer from the lava is by conduction through its solid cooled crust, and solid rock is a very poor conductor of heat.